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ABSTRACT

This paper attempts to discover and describe the salient common factors constituting four high school science teachers' role conceptions. In a year-long ethnographic study, two researchers worked as participant observers in various science classroom settings at an urban high school. Teachers in charge of these classrooms were interviewed on issues related to their classroom practices in general and role conceptions in particular. Assertions regarding teachers' role conceptions were made. Teachers see their role as primarily related to classroom happenings; they maintain a sense of groupness through planning and organizing learning activities. Teachers envision part of their role to be subject matter specialists and some of them try to attract high enrollments in science courses. The paper offers suggestions regarding possible factors contributing to high school science teachers' role conceptions such as: (1) their role models; (2) educational background; (3) socialization by peers; and (4) job protectionism. Implications of these teachers' practices and role conceptions are highlighted and specific implications for teacher education are discussed. (YP)

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High School Science Teachers' Role Conceptions as Reflected in Their Classroom Practices and Discussions. (Draft)

Abstract

This paper attempts to discover and describe the salient common factors constituting four high school science teachers' role conceptions. In a year-long ethnographic study, two researchers worked as participant observers in various science classroom settings at an urban high school. Teachers in charge of these classrooms were interviewed on issues related to their classroom practices in general and role conceptions in particular. As they interpreted observations and other data sources, the researchers took a symbolic, interactionist view. Assertions regarding teachers' role conceptions were made. Teachers see their role as primarily related to classroom happenings, they maintain a sense of groupness through planning and organizing learning activities. Teachers envision as part of their role to be subject matter specialists and some of them do much to attract high enrollments in science courses. They look at their tasks as more demanding than others. The paper offers suggestions regarding possible factors contributing to high school science teachers' role conceptions such as (1) their role models, (2) educational background, (3) socialization by peers, and (4) job protectionism. Implications of these teachers' practices and role conceptions are highlighted and specific implications for teacher education are discussed. Contrary to curriculum designers' expectations, high school science teacher, often lower cognitive demands on their students. Also, they tend to avoid involvement with students' learning problems.

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I. Purpose of Study

Teaching, as aspired by many, is challenging, complex, and, of course, human. Classroom pratices constitute a major part of this process. This study seeks to describe four high school science teachers' daily classroom practices in order to delineate the practices' underlying, salient, common principles that reflect the teachers' classroom role conceptions. This study is, therefore, guided by the following quesitons:

1. What roles do science teachers conceive for themselves when they practice science teaching?
2. What are the factors that influence science teachers' role conceptions?

II. Conceptual Framework for Study

The theoretical basis of the study is the theory of symbolic interaction developed recently through the work of Meltzer and Petras (1975) and Blumer (1969). According to Blumer symbolic interactionism rests on three simple premises:

1) Human beings act toward things on the basis of the meaning that the things have for them.
2) The meaning is derived from or arises out of the social interaction that one has with one's fellow humans.
3) These meanings are handled in, and modified through an interpretive process used by the person in dealing with the things he encounters.

The use of meaning implied in these premises is not the application of the meaning generally derived. Instead however, symbolic interactionism suggests that the use of meaning occurs through a process of interpretation which takes place in two steps: self-indication where the individual indicates to himself the things toward which he is acting, and then that person selects, checks suspends and transforms the meaning in the light of the situation in which he is placed. Blumer put together these ideas as follows:

> "...human group life consists of the fitting to each other of the lines of action of the participants; such aligning of actions takes place predominately by the participants indication to one another what to do and in turn interpreting such indications make by the others; out of such interpretation people form the objects that constitute their worlds; people are prepared to act toward their objects on the basis of the meaning these objects have for them, human beings face their world as organisms with selves, thus allowing each to make indications to himself; human action is constructed by the actor on the basis of what he notes, interprets and assesses; and the interlinking of such on going action constitutes organizations, institutions and vast complexes of independent relations." (p. 49)

The process of indications to oneself is of crucial importance to this theory. The human being has a self and he can act toward himself just as he acts toward others. When one is involved in a process of interpretation of others' actions, he does that through pointing out to himself what those actions mean for him. Self-indication, as explained by Blumer, renders the theory of symbolic interaction fundamentally different from those held in social and psychological sciences.

> "Self-indication is a moving communicative process in which the individual notes things, assesses them, gives them a meaning and

decides to act on the basis of the meaning. Environmental pressures, external stimuli, organic drives, wishes, attitudes, feelings, ideas and their like don't cover or explain the process of self-indication. The process of self-indication stands over against them in that the individual points out to himself and interprets the appearance or expression of such things, noting a given social demand that is made on him..." (p. 81).

An individual planning to act, therefore, will consider relevant environmental elements. The meanings he assigns to those factors will eventually influence his choices and decisions. A teacher's involvement in certain classroom practices is seen as a reflective decision based on meanings assigned to various relevant situational factors including demands expectations, dangers, and taboos. Definitions held for classroom situations encountered determine the teacher's role conception. Consequently, each individual teacher develops a personal formulation of how a high school science teacher should interact with students in classroom settings. This formulation helps provide a framework for relatively consistent interpretation of events in the classroom environment as well as consistent construction of actions and responses.

III. Procedure of Study

A human being, according to the theory of symbolic interactions constructs his social action by virtue of being able to interact or communicate with himself. Interaction or communication with himself takes place through the process of designation and interpretation of objects around him. A researcher inteested in human social interactions should, therefore, try to see human beings' objects as they see them. He should also try to understand how the process of designation and interpretation shape, direct or transform the ways in which people fit together their actions. And finally the actions themselves, how they are constructed and how they are seen from the position of the people forming them are also fundamental.

Blumer, in this respect, suggests:

"To try to identify the objects that comprise the world of an individual or a collectivity is not simple or eacy for the scholar who is not familiar with that world. It requires, first of all, ability to place oneself in the position of the individual or collectivity..., second to identify the objects of central concern one must have a body of relevant observations in the form of descriptive accounts from the actors of how they see the objects, how they have acted toward the objects in a variety of different situations..." (p. 52).

An appropriate way to conduct such a study is to accompany the subject as he encounters objects and events, gives meaning to them and then constructs his world. The ethnographic approach adopted in the study served this purpose. For over a year, the researchers acted as participant observers in an urban high school's science classes (physics, chemistry, and biology). During this period, four teachers in three different science subject areas were repeatedly observed. More than 180 hour-long observations were made. The observers conducted both lengthy informal discussions, as well as formal interviews with the teachers. Also collected were specimens of class handouts, lab sheets, and several other pages of relevant data.

Data analyses were done in two ways. The first was partial in nature, as the fieldwork was conducted. For example, some data indicated certain tentative hypotheses. In turn, that suggested a certain direction to the researchers for further data to support or refute these tentative hypotheses. Though the study as a whole has not ended yet, the researchers feel confident about a more comprehensive analysis at this point. Out of the enormous amount of data, assertions have been made, and data supporting and refuting these assertions are included.

IV. The School and the Teachers

1. The School

The high school is a city school located on the boundary between a pleasant upper middle-class neighborhood and a large automobile assembly plant. It draws a varied population of students, over 2,000 in number, representing a range of socio-economic and racial backgrounds with approximately 40% of the student population Black and 15% Hispanic. The school includes grades 9-12. There are over 100 staff members including five full time science teachers one of them holds the position of a department head.

2. The Teachers

Four science teachers were observed and interviewed for this study. The following is a summary of some pertinent personal information about these teachers.

Mr. Smith* is in his late forties and has been a teacher for about twenty five years. He is the science department head and a physics teacher. He teaches four hours each day: three general physics classes and an advanced physics one. Mr. Smith holds a Bachelor of Science with a mojor in physics and a minor in mathematics, and a Master of Science with emphasis on general science. Mr. Smith had had some training with the science curricula developed in the sixties particularly with the Physical Science Study Committee (PSSC) and Project Physics. He worked for some time as a teacher consultant with Project Physics and participated in a related program to train other teachers. He is considered a leader in science teaching by many people including some science teachers, members of his school district board of education and university professors.

Mr. Hill is in his early forties and has been a science teacher for about seventeen years. He teaches physical science, general physics, and general chemistry. He works very closely with Mr. Smith teaching the general physics course. After high school Mr. Hill went to a community college to study biology and chemistry for he had been interested in medicine. Later he changed his mind about medicine and went to a teacher's college and earned a Bachelor of Science in Chemistry and biology with a minor in physics. Some years later he got a grant and went to college again and did some study in physics. Mr. Hill is also a football equipment coach.

Mr. Brown is the male biology teacher in the school (the other biology teacher is female who is not included in this study). He is in his mid forties and has over twenty years of experience. He had a Bachelor

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*All teachers' and students' names used in this paper are not the real names of the persons they refer to.

of Science in biology. He teaches general biology only, five hours a day. Mr. Brown coaches wrestling at school.
Mr. White is the chemistry teacher at the school. He is in his early fifties and has been a teacher for over twenty five years. Mr. White had a Bachelor of Science in chemistry and a minor in physics and mathematics. While in service as a science teacher he earned a Master of Arts in teaching with emphasis on chemistry teaching. He had participated in some of the PSSC and Chem-Study materials. He coaches football at school.
All of the four teachers are white, and married with families.

V. Vignettes of Classroom Practices

This section includes four different vignettes (one for each teacher's classes) that illustrate examples of the teachers' classroom practices.

A. Mr. Smith's Advanced Physics Class

It's about 12:58, two minutes before the beginning of the hour. I am sitting in the classroom. At this time students are still coming in. At 1:00 all students, (12), together with Mr. Smith have already come. Mr. Smith has started to chat with a student in a front seat. As I am sitting in the back I could not hear clearly their chat for there is still some noise. All I can hear is Mr. Smith's comment "smoky letter" which he made when that student read a paper quietly, possibly a letter. It is about 1:03 and Mr. Smith appears ready to start the lesson. "Let's now do a little bit of review and then take the quiz," he announces. Soon after that he starts to talk about static electricity. He explains that there are two types of electrical charges, positive and negative charges. There are two types of forces, attractive, between opposite charges, and repulsive between similar charges. Mr. Smith summarizes these ideas on the chalkboard. Now he draws an electroscope on the board fig (1) and starts to ask some related questions:
"Here (pointing to the electroscope) is an electroscope. Bring a positively charged rod and then make it touch it. What happens? ... John."
John: "Electroscope will be positively charged."

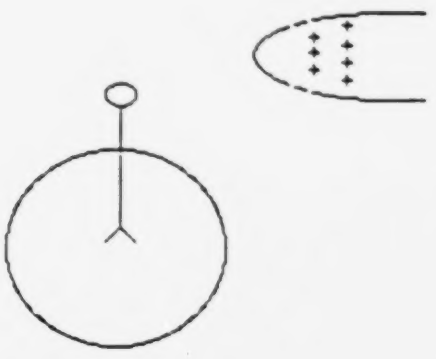

Fig. (1)

Mr. Smith: "Okay, two differently charged plates among them is a light hanging ball" (he quickly drew the plates and the ball on the board (fig. 2). "Describe what happens to the ball as it moves between them?" Mr. Smith doesn't wait for an answer, he starts to explain how the ball will fluctuate between the plates transfering opposite charges to each of them until there will be no more changes on the plates and the ball will stop.

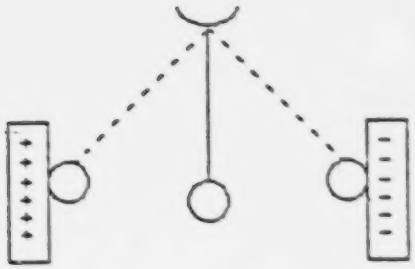

Fig. (2)

"How would you determine the type of a charge on the electroscope?" Mr. Smith starts another point. He then continues to ask. "Let's assume we bring a positively charged rod to the charged electroscope; what would happen?" Again without waiting for a student response he starts to explain how the leaves will diverge further if their charge is similar to the rod's charge (positive charges in this case), and will fall considerably when charges are opposite.
Immediately after this explanation he makes the following drawing on the board (fig. 3) and then asks:

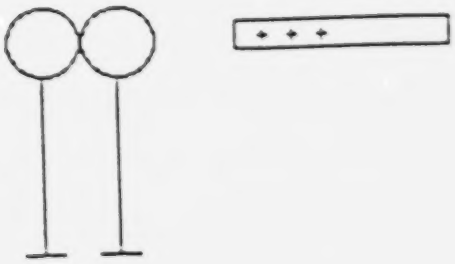

Fig. (3)

"What would happen to spheres when we separate them?"
A student instantly explains that "they will be oppositely charged."
Mr. Smith starts another drawing (fig. 4). He now asks: "Remove finger, remove rod; what would happen?"
A student responds instantly, "the electroscope will have a permanent positive charge."

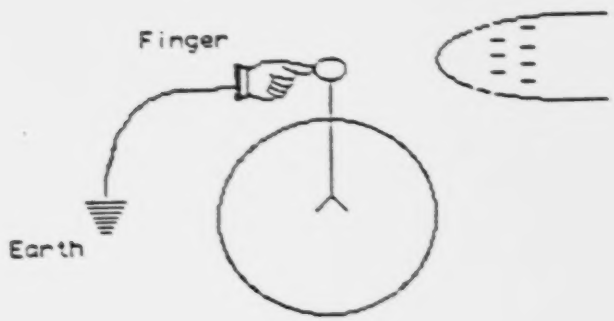

Fig. (4)

Mr. Smith nods the answer right. He starts to distribute the quiz papers.
It is now 1:20 and students have just started to work on their quiz which included questions very strongly related to the ideas which have been reviewed. In the meantime Mr. Smith comes close to where I have been sitting, takes a seat next to mine and starts a discussion over the new proposal by the school district to add another science course during the coming academic year. He notes "we made a survey over what we have and it turns out that we need three extra teachers and three rooms. I talked to the principal and though he had been a science teacher himself, he did not support us. So if you talk to Jim (Dr. Gallagher) about it then you may do something about it." "O.K.", I responded and asked if they prepared any written materials on this matter. "Yes, we have prepared a memorandum; three heads of science departments in three high schools have worked on that," he replied (Later he gave me a copy of it).
It is 1:40 now, students have completed the quiz and handed their papers in. Soon after that Mr. Smith engages in a sort of discussion or review of the quiz questions, a repetition of previous ideas.
It is now 1:55, bell rings and students are dismissed. (Fieldnotes, March 7, 1985)

B. Mr. Hill and His Physics Class

It is 9:55 as I am entering the physics room preparing myself to observe the ten-o'clock physics hour. I don't observe Mr. Hill often, however, very often we exchange views about science teaching in general and physics teaching in particular. Mr. Hill is here in the physics room. "Hi Ken," I greeted him. "Hi, Ribi," he responded. "What do you have for today," I asked. "We will have an activity today; rocket launching," he replied.

Mr. Hill starts to look for Tom (a student teacher) to help prepare the rockets. He leaves the room and goes to the chemistry room. Moments later he comes back alone and then both of us start to prepare the little engines of the rockets. While preparing for the rocket demonstration, Tom comes and the three of us move to a second room where the rockets were kept. Mr. Hill starts to show Tom how to prepare the rockets; load them with their little engines and connect the ignition part which will eventually be connected to a battery. A few minutes later both Mr. Hill and myself left the room while Tom stayed there to complete the preparation.

It is 10:30 and Mr. Hill is looking for a battery to use it in the launching. After unsuccessful search he decides to use his car battery and so we both go down to his car and drive it to the "launching site", the playground. In the meantime we discussed various things but most importantly physics demonstrations and their role in physics teaching. Mr. Hill explains to me that that particular activity is very attractive for students. "We stopped this activity for a couple of years and enrollment went down, and so we decided to try it again," he notes.

At 11:00 all of us Mr. Hill, Tom and myself are at the "launching site" with all the paraphernalia. Some of the students have already preceded us to the place. At the site a student by student would come with his or her rocket loaded and ready for launching. Each student would be shown how to set the rocket and make the necessary connection. A countdown would start and the little rocket would soon be rocketing up to possibly over a hundred feet. The scene is spectacular and everybody seems to be just excited with the activity. A whole hour has been barely sufficient for the activity.

(Fieldnotes May 3, 1985)

C. Mr. Brown and His Biology Class

It is 11:00 as I am entering the classroom. Mr. Brown is preparing the movie projector. There is a lot of noise as students are talking loudly to each other. "Ladies and gentlemen, bell rang let's quiet down," Mr. Brown reacted to the noise. Class becomes quiet and Mr. Brown starts to take attendence silently. "Chapter thirty six, we had a review yesterday," he remarked. Then he goes on to explain that he will show them a film on reptiles' characteristics and evolution. "Watch the film closely to pick up what is necessary for the test," he instructs his students while being just about to run the machine. The film is started at 11:04. It explains the evolution process starting from fish to amphibians and then reptiles. Characteristics related to tounges, skin, coldbloodedness and orders of reptiles such as lizards, turtles, crocodiles, snakes, and camilia are discussed. At about 11:20 film ends. "Open your books on chapter thirty six and review for the test," Mr. Brown instructs his students while rewinding the film. He then goes on to note "yesterday we reviewed the labs. Out of book you should know the era of reptiles page 465,466; era of dinasours, terrible lizards, and many other examples." In the meantime Mr. Brown is paging through his textbook. Now he starts to refer to some other pages: "Page 469, characteristics of reptiles; know three different orders you did in the lab; lizards, turtles, and snakes. Four hundred seventy one, several types of lizards, review these. Four hundred seventy two alligators and crocodiles, structure of shells for

turtles." He also raises some very short review questions to which he gives instant brief answers. Examples: He asks (reading from the book) "What are the most widespread reptiles?" He immediately answers "snakes". (He asks and answers while sitting on the front table) "What are the two different methods of birth in snakes," he asks again. And instantly he explains that snakes may lay eggs or keep them inside their body till they hatch.
"If you have any questions ask," he seems to finalize his review. However none appears to have a question. He, therefore gives his next instruction "open your books and read quietly."
It is 11:30 and students start to open their books. Moments later noise starts to rise and Mr. Brown, while sitting at his desk reacts to the loud noise, "you shouldn't be talking, you should be reviewing. This is not a social hour." Class becomes quiet again... (for the rest of the hour the fieldnotes describe students looking at their books, talking together and Mr. Brown working on some papers at his desk). (Field notes April 9, 1985)

D. Mr. White and His Chemistry Class

It is noon time and I am in the chemistry classroom. Mr. White starts to turn back to students their checked homework. Five minutes later Mr. White appears ready to start today's lesson. He starts to review Dalton's model of the atom:

Teacher: "Cathy, why atoms were important?"
Cathy: "I don't know."
Another Girl student: "is it because of those laws?"
Teacher: "Yes and some other laws. When we put together a bolt and a nut we reduce the number of things. If matter is made up of particles, then we explain the whole number relationship. Interaction takes place at the particle level."

Students attention at this point is divided and the teacher, Mr. White is repeating again the previous ideas about particles and molecules. Mr. White starts to review another important concept, namely the Thomson model:

Teacher: "What was the Thomson model?"
(pause for seconds, but no answer is given)
Teacher: "What was the motivating factor for the transition from Dalton's to Thomson's model, Susan?"
Susan: "I don't know."
Student A: "The discovery of the electron."

The teacher at this points reminds his students of the basic assumptions about Thomson's model. Then he turns to Rutherford's scattering experiment.

Teacher: "What three significant observations did Rutherford make in terms of behavior of alpha particles?"
Student B: "Some alpha particles bounced off."
Student A: "Some particles deflected and majority passed through."

Mr. White agrees on their answers and then referring to Thomson's model he notes, "now if the model is correct then it should give credibility to observations." At this point three students appear completely inattentive, they are closing their eyes and seem to be sleepy. Only around five students appear attentive and interested in participating in the discussion. Mr. White explains how that Rutherford's observations don't support Thomson's model of the atom, "so what to

do?, he asked. He maintains that the model should be adjusted. He now seems to be ready for another series of relevant questons.

Teacher: "Why did the particles bounce off?"

(pause for a few seconds but there is no response)

So Mr. White reasons that "there must be something heavy."

Student A: "Why did some penetrate?"

At this point Mr. White brings in the analogy of scattered poles in a field and people walking in that field (poles stand for nuclei and people for alpha particles). He then concludes that according to the Rutherford model "atoms should have a central region called nucleous with mass and positive charges in that nucleous.

Teacher: "What pattern did Rutherford use to establish his model?"

(A long pause for about half a minute)

Student A: "Solar System."

Teacher: "Yes."

It is now 12:40 and the sleepy students still appear completely inattentive. Mr. White starts now to talk aobut "a problem" in the Rutherford's model. The problem as he explains has to do with an anticipated result at the time that electrons in that model would eventually lose some of their energies and spiral down and collapse on the nucleous. Mr. White brings in another analogy where a mass is connected to the end of an elastic cord is moving in a circular path around the other fixed end of the cord. When the mass looses some of its kinetic energy it will approach or "fall down" toward the center. However, many students appear not to be paying attention to what he is explaining. They appear restless. Mr. White concludes his lesson by pointing out that there are "weaknesses" in Rutherford's model. He however asks a final question, "What would be these weaknesses." The bell rings at this moment and students start to leave the classroom.

(Fieldnotes Dec. 14, 1984)

VI. Assertions

Based on both teachers' classroom practices and formal and informal discussions and interviews with those teachers a set of assertions pertinent to role conceptions have started to emerge. Each of these assertions has been supported by substantial data. However instances that may yield what may be seen as refuting data are not rare in the study.

1. Teachers' envision their role as primarily related to classroom events and happenings. In their formal and informal discussions they almost always talk in terms of things related to their students and what they do or don't do in the classroom. In a formal interview when teachers were asked about the various important things they do as science teachers their responses were always in terms of classroom matters:

Mr. Smith: "You are an engineer, a creator of their (students) experiences with your subject."

Mr. Hill: "Leave students with some facts about subject matter. Leave students equally prepared for a technical society."

Mr. Brown: "Go over the subject untill students understand."

Mr. White: "Be able of approaching explanation."

Other school affairs are not seen as equally important. Administrational affairs, for example, have not been cited as matters worth of science teachers' thinking or interest. An interesting

response comes from the department head, Mr. Smith, who responded to a question about his role by saying among other things: "I am not a hatchet man with the principal's word enforced on science teachers."

2. Teachers envisioned part of their role as being a group leader and maintaining their classes as groups. There was no question about who was in charge in classes. As the excerpts from classroom practices show various ways of instruction, one common factor among them is the fact that they are all modelled to allow a leading role for the teacher among the classroom participants. Teachers try to moniter all verbal interactions, initiate almost all activities and perform nearly all evaluations. Three of the four teachers, however, act as cordial group leaders, the fourth, Mr. Brown, is more formal and autocratic.

3. Teachers envisioned their key role as instructional content planners, organizers, and presenters. Planning tends to be mental rather than written and general rather than specific. This is very clear in the excerpts of classroom practices cited in this paper. They present their students the content they deem necessary with some form of organization. This key role is reflected more explicitly in the interviews. When they were asked what kind of a science teacher you see yourself as, they responded in terms that are congruent with their classroom practices:

Mr. Smith: "Humanist, on the side of the student, both of us are going to explore physics rather than a physicist challenging students to bring themselves to me.... My course is for a broad base. We look at things that college don't look at like the history of an idea. A student taking my course and going to college will have the best of two worlds breadth and depth."

Mr. Hill: "Science teachers should try to teach skills, data, number, patterns. Skills like using equipments, batteries. Understanding technology is also important."

Mr. Brown: "My role is to guide the students into areas they need to get information from, learn from. To be a resourse for them to gather information. Give them the information or the other resources they need to learn and absorb the information been taught in class."

Mr. White: "Positive science teacher. I do a good job in presenting and explainign material."

While Mr. Smith's response is given in general terms other teachers' responses are more explicit in their orientation. They present information to students through assignments, lectures, films and lab activities. When teachers were asked about the way they plan for their lessons their answers didn't emphasize daily planning, instead they talked about "looking at past papers," "variations in planning and mental planning," "we do a lot of paper generation ourselves."

4. Science teachers tend to emphasize the subject matter as the most important component of the content of their instruction. They also tend to look upon themselves as subject matter specialists. Teachers' practices tend to agree with this assertion. However there are some variations in their responses to pertinent questions and discussions. While Mr. Smith looks upon himself as "a humanist" and deals with his advanced physics course as "a broad foundation" which "doesn't attempt to be a miniature version of a college physics course," the rest of his collegues see things differently. Mr. Hill speaks of himself as an

"expert on technology to some extent," while Mr. White seeks to "provide college background in chemistry" for students taking the advanced chemistry course, and Mr. Brown talks frequently about being "a resource guide" for his students studying biology. It is interesting to note here that when science teachers were asked about their educational background, they all tended to make conspicuous the science component of their education. Some of them mentioned other components like education courses or training only when they were asked specifically about that. There is another confirming instance for this assertion. One question that was asked of teachers during the interviews was "How might we (project staff) help you do a better job of teaching science?" The caracteristic reply of teachers was that staff members could provide an "extra pair of hands" in helping teachers with lab activities. They also expressed their willingness to participate in seminars where scientists (physicists, chemists or biologists) would discuss some specific topics in science. None of them showed signs that they perceived a need for assistance with instructional planning and organization.

5. The teachers were divided regarding their role as "gatekeepers". Two of them (Mr. Smith and Mr. Hill) felt their responsibility was encouraging more students to study science. They stimulated enrollment through various methods that appeal to their students. Photographs of students and teachers working together in the lab together with some occasional pertinent posters or printed materials are displayed at a visible spot adjacent to the physics rooms. Exciting demonstrations similar to the rocket launching one cited in this paper are also used for this purpose. The other two teachers tended to be less open to student recruitment and did less to make the courses appealing. Rigor in treatment of many science topics is very frequently avoided and students' grades tend to be not frustrating.
6. Science teachers look at their classroom tasks as more demanding. When teachers were asked explicitly to compare their tasks with others they responded with statements like, "Physics is the toughest job, equipment, repair order, demonstrations, experiments. Different from teachers say page 28..." ; "In some cases it is more demanding, it is not a paper and pencil work."; "Lab work requires extra work.";"We show patterns, experiments."

VII. Factors Contributing to These Role Conceptions

1. Role Models.
   When teachers were asked about people served as their role models, they frequently mentioned university professors or other science teachers. In all of these cases, the role models were remembered for being "very easy going and relaxed" or "good presenter and organizer of subject matter." It is interesting to note here that science teachers though remembered with admiration their high school science teachers, don't model them because they had been "inflexible."
2. Educational Background.
   Science teachers' educational background includes study of both scientific and pedagogical content which influenced role conceptions. Pedagogical instruction appears to have contributed to teachers' role conceptions as group leaders and instructional organizers. However, it appears that emphasis has been lacking on diagnostic and remedial roles as part of these teachers' professional education.

3. Socialization by Peers.
   The "cultural norms" within science teaching provide little incentive for teachers to engage in diagnostic and remedial activity. General beliefs regarding school science appear to be that (a) it is difficult to learn and (b) able and motivated students will learn it while others will not.
4. Job Protection.
   In the high school studied, science was only recently required for graduation. Therefore, teachers who wanted to maintain sufficient enrollments to ensure graduation of their job were forced to compete with their peers to attract students into their courses. The two physics teachers in the school responded in an entrepreneurial manner by recruiting students into physics and setting instructional conditions that would retain them. Physics, thus, became more interesting and less demanding as a means of attracting and holding students. Teachers adopted a cordial, supportive stance toward students which enhanced success and minimized the "threat" usually associated with physics courses. It is interesting that the support the teachers provide focuses more on quality of interpersonal interactions than on improved analysis of difficulties in learning complex content.

VIII. Implications for Teaching Science

Science teachers' role conceptions have implications for science curriculum designers. In this study, which may not be generalizable to all high school science teachers, it is concluded that teachers kept the cognitive demands on students at a rather low level. Emphasis on inquiry methods, reasoning and analytical thinking contained in introductory pages of science texts was very significantly diluted or relaxed in some classes and barely existent in others. Furthermore, science teachers tended to think of their students as two groups: those who can make it even without the help of their teachers and those who can't (or won't) regardless of any efforts their teachers may offer them.

The results of this study have important implications for school leaders, teacher educators, and the science education community. It seems as though, schooling conditions in general and science teaching conditions in particular force both teachers and students to unspeakingly bargain or negotiate content coverage, standards, and time in ways that are both overt and subtle. Within the terms of this tacit agreement, both teachers and students followed a path of least intricacy, a path that avoided serious involvement with students' learning problems. This negotiation between teachers and students can be sharply influenced by teachers' role conceptions. Our understanding of role conceptions of teachers is, therefore, of consequence. Important questions are raised at this point. First, to what extent are the findings generalizable to other high school science teachers? Second, what are the additional contextual factors that influence science teachers' role conceptions? Third, what educational or social models would help us enrich our interpretation of these findings?

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